Synchrotron Radiation X-ray Fluorescence Imaging of Biological Model Organisms Manipulated by Laser-Based Optical Tweezers

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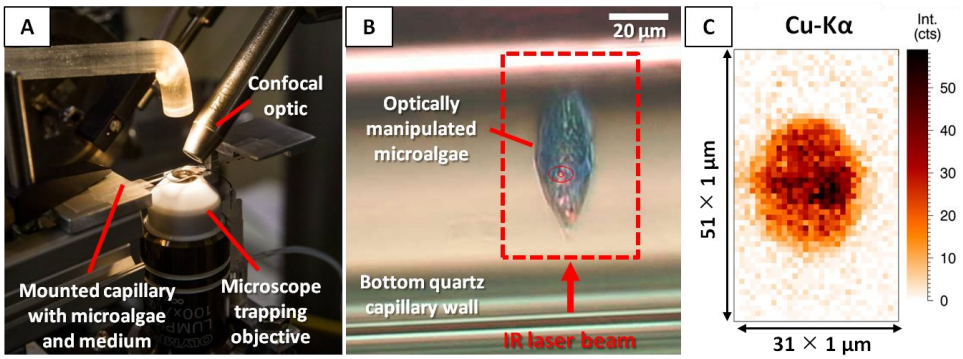
Owing to its high sensitivity and non-destructive nature, synchrotron radiation based X-ray fluorescence computed tomography (SR XRF-CT) and confocal XRF imaging are emerging methods that provide three-dimensional information on elemental distributions with trace level detection limits. We propose a new methodology that combines these techniques with optical tweezers (OT) based non-contact sample manipulation for micro/nano-XRF imaging. In short, optical tweezers use a focused infrared laser beam for optically manipulating a sample within an aqueous environment, enabling non-contact sample positioning. The objectives of the new methodology involve the investigation of free-standing biological micro-samples in their natural state, thereby eliminating the time-consuming and error prone sample preparation.

In 2011, Santucci et al. reported on the development of a dedicated OT setup (Fig.1-a) for SR XRD probing of trapped biological objects (i.e. insulin and starch crystals) in an aqueous environment [1]. During the past years, the compact OT setup was further optimized and several biological model organisms were tested for their trapping properties. In March 2014, *Scrippsiella trochoidea* microalgae (Fig.1-b) that were exposed to high metal concentrations (Cu, Zn and Ni) were manipulated and kept stable using the compact OT setup and at the same time scanned with confocal SR micro-XRF. The corresponding Cu distribution of the microalgae is shown in Fig.1-c and proves that the *novel* combination is successful. This presentation reports on the *very first* results of the *radically new* OT/micro-XRF methodology.



[1] S.C. Santucci, et al. Analytical Chemistry 83(12), 2011, 4863-4870.